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SCIENCE

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THE PRESENT STATUS OF THE HISTORY OF SCIENCE IN AMERICAN COLLEGES AND UNIVERSITIES

DURING the past few years there have been several attempts to establish beyond question the value of a study of the history of science in American colleges. A little has been written in defense of the subject as a proper part of the curriculum, and a few science teachers have spared no effort in the critical study and presentation of the history of the particular phase of science with which they have been most familiar. And yet, the papers that have been written in English dealing at all directly with this history are so few in number that they all may be read in a very few hours. Of histories of science—books relating to the subject matter itself—there are even fewer, so it is not surprising that the otherwise busy teacher has not been drawn into this phase of his science by any sense of an ample amount of readily available material. At the same time, those who have considered the matter seriously have usually become strong advocates of the value of a study of the development of science, both for its service in explaining the present status and aims of science, and also for its value as a picture of human development that probably is not to be equalled in educational value by any survey of political or military movements.

With this conviction, the present writer undertook to ascertain in just how far the history of science was being studied in American colleges and universities. Questionnaires were sent to the deans or presidents of nearly four hundred institutions throughout the United States. While such instruments are necessarily imperfect, and the individual findings perhaps often unreliable, the total mass of material thus gathered together is not without point, and it indicates among other things, that inter-

est in the history of science is far from lacking among American science teachers—that it has, in fact, developed to the point where the majority of them welcome any opportunity to urge a wider study in this field.

In only two or three institutions are conditions such that one man can devote the major portion of his time to the history of science alone, although several of the larger universities seem to be considering the establishing of such a professorship. A more usual method has been that in which a science professor has crowded in with his other courses, one dealing with the rise of his science, or has given a series of supplementary lectures along with a regular course, or perhaps, quite distinct from it. Some teachers have found it impossible to devote time to such work beyond that required for reports or occasional papers on subjects assigned to the students. But all, or nearly all, where there is evidence that they have given the matter serious thought, have agreed that here is a rich field as yet unexplored sufficiently to make clear the best method for its development, but nevertheless one which is full of material as conducive to the understanding and solution of present-day problems as any other.

HISTORY OF GENERAL SCIENCE

Very little has been accomplished by way of giving a course which might properly be called a history of general science. The reasons why such a course is probably well nigh impossible are not difficult to find. Yet, in one institution—small enough so that one man teaches the several sciences there offered—this instructor believes that he has been successful in giving a history of natural science as a whole. Such an experiment is interesting, but it should not be misinterpreted. The very fact that all of the science courses offered are necessarily more or less introductory, means that only the growth of the simpler developments can be reviewed with intelligence, and the limitation of time reduces the work to a series of excursions into the several recognized divisions of natural science. In the words of one who is himself one of the best-known American

historians of certain limited phases of scientific endeavor,

No one instructor can give a course worth giving on the History of General Science!

A somewhat better procedure—and one that will be discussed more later—is that in which by means of the collaboration of instructors in each of several sciences, it has been possible to organize a regular course or a series of extra-curriculum lectures touching ably the several branches represented. This method has the weakness of presenting the subject matter disconnectedly, and what the majority of the listeners gain will be in inverse proportion to the extent of the survey attempted. If only a very tiny bit of the lore in a given science is examined, it may be productive of some permanent mental impression. Such glimpses at several of the brighter spots in the history of the various divisions of science do not in any true sense constitute a history of science as a whole, or in parts that may be closely related. But that this method recommends itself is proven by the fact that it has been tried out several times and one of our largest universities is now considering the establishment of such a course.

Some of the colleges are offering what they designate as a history of general science, with the announced intention of making it purely introductory to a more intense study of special sciences. This practise, however, is not in accord with the general feeling of science teachers. The majority of them state frankly that they regard a knowledge of the fundamental principles of a science as absolutely prerequisite to any intelligent study of its growth. Where the rise of science is considered in a general way by the department of philosophy, it would naturally come late in the college course, and hence could scarcely serve as introductory to other undergraduate studies.

One or two colleges offer courses on the history of science extending through one semester only. Apparently this work is open to any one seeking a brief diversion from the things of the present, and while it is surely

of some value—presumably more to the instructor as the nucleus of future courses of the same type, than to the student—it must quite necessarily be regarded as one of the excursions referred to above.

Another institution gives a lecture course—one lecture a week—under the title of "Science and Scientists." This is open to freshmen and sophomores in Arts and Business Administration. It undoubtedly serves to show these young people that there have been great factors in human development other than those in which they are specializing—but it, too, is hardly of sufficient scope to be classified as a history of science.

In colleges where special attention is given to the preparation of science teachers, it has been natural to introduce into the regular courses of a more or less pedagogical nature quite a bit of historical material. And this is as it should be, for the students here in attendance are presumably somewhat familiar with the science they intend to teach, and can derive the maximum benefit from whatever historical glimpses they may be offered. If they have a real love for their subject they will fill in many of the gaps with their future reading and thus gradually acquire a measure of the historical sense in no way to be despised as a part of their scientific background.

There are a number of methods by which historical investigation and instruction may be carried into the general field of science. All have been tried with more than tolerable success. At present we can only refer to them sufficiently to indicate their approximate natures.

First, there is the public lecture course given by men belonging in the institution, or brought in for the occasion. These lectures may be in the form of a number of intimate views of a period, of the development of the science of a certain people, of the growth of a definite line of science, or each in itself may be quite complete, and otherwise wholly disconnected from the others. Whatever the form actually employed, where the speakers know their subjects, make all

possible use of modern forms of illustration—lantern slides, charts, models, maps, etc.—the impressions gained by the listeners can not be other than lasting and altogether beneficial.

Where only a small amount of time can be given to the lectures each week, it is possible to carry the course through more than one year and thus cover the ground quite comprehensively. But such an arrangement usually means that attendance is optional, and without great effort it would be difficult to keep up such an interest and receptive state of mind as might obtain at the occasional lecture.

For a long time the seminar method of delving into the history of a science has been familiar. Where weekly departmental meetings are open to all who are sufficiently trained and interested to make their attendance profitable, the atmosphere of the gathering may engender real enthusiasm. It may result in an almost religious feeling towards one's beloved science, and hence, is a form of education which should be encouraged and maintained regardless of more systematic courses which may profess to cover the same ground. Subjects studied in course can not acquire the quality obtainable in the close communion of a few who have been drawn together because of a common interest in the subjects themselves, quite apart from the idea of payment in the form of credits towards graduation.

Closely connected with this sort of organization are the societies or clubs. These may range from the very elementary undergraduate groups to the postgraduate societies with or without affiliations extending to other institutions. One of the best examples of what a scientific society may accomplish was afforded recently by the Yale Chapter of the Gamma Alpha Graduate Scientific Fraternity, under whose auspices a series of lectures was given. Each speaker was a leader in his line, and each covered in a brief but quite comprehensive way the historical growth of his own branch of science. Thus there were delivered, and later printed, admirable sur-

veys in the fields of mathematics, chemistry, biology, psychology, physics, geology and astronomy. Naturally, these were not of a type suitable for elementary presentation.

One institution—a college of engineering—gives a two-hour course on the history of science to all sophomores. In another, two courses have apparently gradually merged into one. For many years a course dealing with the history of the inductive sciences had been offered by the professor of biology. Later he was joined by the professor of mathematics, and between them they rounded out the course into a fair approximation of a general history of science, or more correctly, a brief history of several associated branches of science. The usual limitation of time made it impossible for them to cover everything, and so, *e.g.*, the history of chemistry was handled independently by the professor in that department. The lecture notes of the two men thus associated finally reached such proportions that they were printed, and now form a well-known elementary text on the subject. According to one of the authors, the real object in putting the material into book form was to lessen the dependence of the students on the lectures. As originally worked out, the time was divided about equally between the two instructors, the mathematician covering most of the Greek period, and mathematical science previous to the calculus of Newton. The biologist has traced the development of modern science and the special phases of the entire review with which he was most familiar. Each student is supplied with blank forms for his reports on collateral reading of biographies and other historical subjects in connection with the course. Essays are required, for it has been the feeling of the instructors that nothing short of this written work secures a sufficiently intensive study of the assigned reading matter. The two parts of the course may be taken independently, and although the work has been elementary enough to make no definite prescription of preliminary scientific work necessary, it has quite naturally been found that

"some degree of scientific background and some maturity are desirable."

This method of procedure has been discussed here somewhat in detail because it shows very admirably what may be accomplished by pioneers. However inadequate such courses may seem, they are of the type that may be organized in almost any college if there is but time. The form of cooperation will depend on the men and material available.

A well-known college for women has found some value to be obtainable in a collateral reading course which is carried on privately throughout two years. In still another college, the cooperative method referred to above has proven quite successful. Apparently, the department of philosophy gives two lectures a week on "Life Views of Great Men of Science." At first this would seem like a rather large responsibility for such a department to assume, but the college catalogue shows that associated with the instructors in philosophy—one of whom is the president of the institution—are men from the departments of astronomy, geology, chemistry, mathematics, physics, anatomy, physiology, zoology, economics and sociology. Such wide cooperation, while not free from some of the objections made above, is most gratifying and must make not only for good feeling between the several departments, but serve the students as material evidence that each so-called science is only one phase of a great body of truth—that its various developments are all aspects of one growth.

In one of the greater universities, two associated courses are given, one a "History of Science from the Physical Standpoint," and the other, a "History of Science from the Biological Standpoint." The lecturer in each case occupies a prominent place in his chosen field. Undoubtedly, these courses are primarily historical reviews of physics and of biology, respectively, and should be classed with the rather narrow histories of specific sciences to be considered later.

In another university there has for some time been given a composite course dealing

with biology and physics. The lecturer himself is a physiological chemist, and would be expected to take the experimental viewpoint. Such a combination of these subjects is quite natural when one considers the parallel steps in their development. For example, how closely were they connected in the early work of the Royal Society, and how evidently is the apparatus of modern biology borrowed from the physical laboratory! In this same institution a special lecturer has dealt with specific phases of the history of science, and also written much, advocating its wider study. His method seems to be that of following the growth of an idea and the philosophy involved. Both methods of approach are proper and will undoubtedly leave their separate imprints on the later forms in which the history of science will be handled.

One further arrangement for approaching this subject in a general way may be mentioned, although the course referred to is not offered primarily as a history of science. At a certain college a general culture course has recently been organized under the all-embracing title of "Evolution." The fact that it is given by the department of biology might lead one to expect the usual restricted meaning of the term. However, in the words of one of the instructors responsible for its direction,

It is a composite course that covers so wide a field that the bare facts are emphasized rather than historical development, although the latter is by no means ignored. Fundamental chemical and physical principles are given without any historical setting, but the lectures on astronomy necessarily take up the historical side, especially in the development of evolutionary theories. The same may be said for the biological lectures where we cut out all possible detail yet give a skeleton outline of the contributions of the more celebrated men to the theories of organic evolution. The course ends with a review of the present known facts regarding the organic development of man himself while a certain amount of time is given to social and mental growth (culture).

As this course itself is still in the early stages of its evolution, its real value can not as yet be ascertained, but it is not impossible

that it, too, may serve as one of the pioneer attempts that will form the basis for the future courses on the history of science.

HISTORY OF SPECIFIC SCIENCES

There are many evidences that much more success has been obtained in the shaping and conducting of courses on the history of the specific sciences than where the whole field of science has been engaged in a single campaign. Here the difficulties to be met by the lecturer in crossing the boundary between two branches of science are largely avoided, and although the interrelation of the several sciences can not be lost sight of, his natural limitations do not prevent him from presenting the history of his specialty in a manner that is sufficiently connected to lead to logical conclusions. He is able—by limiting his attention to a single field of development—to secure a picture so complete as to impress the student's mind with the one fact of paramount importance, namely, that he is reviewing a growth, one that never goes backward, and one which in its latest stage—the present—is an integral part of the world as he now sees it. Such a study, to be of greatest worth, is, of course, suitable for advanced students only in the particular science to which it relates. Here is an unquestionable case in which the advocates of prerequisite scientific training are thoroughly sound. The field is not new. Enough has been written to make great blunders no longer unavoidable, and many such courses are at present being offered in American colleges, though so far their usefulness has been limited by the lack of time on the part of the teachers and the failure of others to appreciate the value in such things in this age of seeking after immediate practical results.

Naturally, mathematics is one of the leading subjects whose history is now being taught as an independent course. The maturer the student and the wider his knowledge of the methods of mathematics, the greater will be his pleasure and benefit from a review of the philosophy and labors that have developed the powerful mathematics of the present. In some institutions it has been possible to combine something

of the history of mathematics with a course on the methods of teaching mathematics. Then, too, there are the usual variations—special lectures in connection with or supplementary to the regular mathematical courses, seminar work, etc. Closely associated with historical studies in pure mathematics are those, such as the histories of astronomy, civil engineering, analytical mechanics, and mathematical physics.

Where the history of a special science is handled by a member of the department of instruction devoted to that science alone, the viewpoint of the scientist, *i.e.*, the viewpoint of the original investigator and discoverer whose work is being studied, may be presented. The physical equipment within the department affords not only a convenient but absolutely essential means of illustration. In many cases, this may and should involve the actual repetition, step by step, of the classical experiment or investigation. All possible pertinent material should be acquired for its usefulness in this particular course, and that this can be handled to the best advantage only by the specialist, goes without saying.

At present there are offered in this country courses dealing solely with the histories of mathematics, physics, chemistry, biology, zoology, botany, evolution, anthropology, astronomy, geology, psychology, medicine, pharmacy, home economics, engineering, and probably many others. In some cases there are evidences that these subjects have been offered because of the vision of a single man who not only launched the work, but maintained it personally. That this has often been so is shown by the fact that the course has been allowed to lapse after the departure of this particular teacher. Those who remain are kept too busy to carry on the work, although the majority of them have expressed the firmest conviction of its worth.

The historical courses in these main divisions of science are modeled differently in various institutions. A few attempt to cover the entire history of the subject chronologically. In other cases the material is taken up by periods, *e.g.*, the "Development of Chemistry During

the Seventeenth Century." Or again, a very narrow line of growth within the science may constitute the subject matter of the course, such as the "History of the Law of Gravity." Either of these latter methods, though limited in scope, makes possible quite thorough work.

The present high development of the sciences is a thing of such modern times that there is no end of material available for studying the recent portions of their growth. Here again is a task that must be directed by the specialist—one who is familiar with the literature of his science. Probably no physicist would consider himself capable of directing the historical reading and research in the field of botany. Likewise each science teacher would view as puerile the attempts of any one—no matter how capable in a special field—to direct all of the various phases in a course on the history of general science.

From time to time eminent chemistry teachers have conducted lecture courses on the chemistry of a period or the evolution of a chemical theory, although in many cases such instruction is no longer given. Probably this is because the present-day specialist finds little time for such studies in addition to the purely technical work for which he is most admired just at present.

One institution gives each beginning class in chemistry five lectures dealing solely with historical matter. Of course, in all schools some of the history of the subject is introduced from time to time in the regular instruction in the science. Some teachers of long experience have expressed themselves as greatly in favor of giving more time to this history—a special course, if possible—but owing to the difficulty in setting apart the requisite amount of time for such a thorough study, they have had to content themselves with mere references to the historical background. However, this method in any science is not without its good points, for it is one of the surest ways of securing interest, and at the same time it prevents the student from grasping a law or serviceable result as a God-given tool and the only feature worth retaining. It shows him the essentially hu-

man quality that lies under and behind all progress—that all progress is at the expense of human endeavor. And is not this one of the prime objects of education?

The history of physics is only beginning to be fully appreciated. In one of the eastern universities, courses were conducted for a time by the head of the physics department, in which he sought to present "not only the material that can be found in some of the books upon the subject, but also traced the development of certain fundamental fields." He employed the lecture method. His success and possibly the reason why the work was not continued after his departure from the institution, are explained in part by the remark of one of his colleagues.

Professor —— himself was able to add the personal touch of experience in the historical development in many phases of the work in physics.

This, of course, is a brief statement of the ideal qualifications of the director of any course in the history of science.

Often brief courses on special historical subjects, or rapid surveys of a large portion of the growth of a science are opened to prospective teachers. Such work—where the students are well grounded in their subject and where the widest possible use is made of the departmental library—is probably of no small value, if for no other reason than that by enriching the coming teacher's outlook, it will make better the instruction of the next generation.

Where time is limited, a course may be offered, say, once in three years, or the departmental society or club may be pushed into really serious activity. Even extension courses are worth while if the students are themselves teaching and have some library and laboratory facilities at their own disposal. Such work may be closely allied with regular graduate work in the same field.

A suggestion as to how a course may be composed of biographical studies, as well as of a review of purely technical developments, may be gained from the statement that the study of the history of botany in one of the greater universities has "included not only

the evolution of the science, but the lives and contributions of leading botanists, the history of the microscope, etc."

METHOD OF PRESENTATION

The formation of a course in the history of any branch of science has, in the majority of cases, waited for the appearance of some sort of book that might serve as a text. Few instructors have had the time or the courage to plunge into such a course dependent only on their own lecture material and the assignments of collateral reading. No matter how desirable it may be that the teacher should be thoroughly capable of writing his own text, energy and opportunity are seldom available for such an accomplishment.

Almost with one accord, the teachers who have responded to the present inquiry have voiced this need for text-books, for there is very little in English that may be so used. Note that the cry is not because of a lack of original source material for reference or research work, but for suitable secondary sources that present the material in a form sufficiently well chosen and digested to be usable by the beginner and constitute a skeleton about which a course may be built up. This seems to be true even in the cases of those sciences of which one or two quite admirable histories are now available. In addition, little is to be found in book form covering the developments of the last decade or so. Of the few history texts available, there is almost no choice. They are necessarily the same works as used elsewhere and in former courses. For obvious reasons they can not be listed here, but their number is so small that every science teacher probably has on his own desk all that is obtainable for his use at the present time.

These few books are usually the outgrowths of lectures given when there were no texts at all. The years that have elapsed since their publication have put them out of touch with modern advances, although this is a fault which may usually be overcome by the use of references to current literature during the latter days of the courses in which they are used. It is perhaps not surprising that teachers have

been quite harsh in their criticisms, but it is to be hoped that their distress is sufficiently real to drive them to the point of writing something better, for here is one of the few fields in which there are not too many books.

Where a course has been limited to the study of the growth of a theory or of a particular branch of the science, some useful books have usually been available. Single works dealing with the progress of a given era are much scarcer, and, as already suggested, satisfactory works covering the entire growth of the subject are rare indeed. The natural compromise that has resulted is a combination of the lecture and text-book method. To date this form seems to have had the widest trial. Instead of depending upon one book only, the library facilities may be drawn on so as to make use of many authors in addition to the lecture notes. Papers on these outside readings insure a fair degree of application in their use. One teacher employs the lecture method mainly and assigns to the students biographical topics only. In another institution, where several courses in the history of science are given, a text-book in one of them serves as the nucleus about which the course centers, but the class discussion is devoted mainly to points in a set of over four hundred typewritten questions supplied by the instructor. There are also reports on outside reading. In the psychology classes, finding no book suitable, the lecture method has been employed almost entirely. The same is true in the history of pharmacy, but also for the additional reason that at the time of the report the class had over one hundred and twenty members. In medicine, at this institution, the lecture method is supplemented by an assigned paper on a historical subject to be chosen by the student himself.

In connection with this question of the form of presentation of the subject, it is interesting to note the method employed by one instructor in chemistry. He wrote:

I let the class decide which style they prefer. If they are preparing to teach chemistry, they seem to prefer a text-book, otherwise they choose the lectures.

He says nothing about any difficulty in getting the members of the class to agree.

Another method, and when it can be carried out consistently, the one most in keeping with the fact that any historical study should be an attempt to see for one's self as clearly as possible just what has transpired, and what were the immediate causes contributory to the various progressive steps in the growth of the science, is that where the lecture method is combined with the reading of original sources. Many a small college library contains much material that may be used in this manner, *e.g.*, the *Philosophical Transactions*, and the scientific journals that have been published during the past century. Reprints of older sources are now available on quite a number of subjects, and fragments of original papers are often to be found in encyclopaedia articles and elsewhere, so that with diligent searching the instructor will usually be able to make a beginning, and he may be surprised at the wealth of material close at hand.

The type of material obtainable from current periodicals is too familiar to need discussion here. *The Readers' Guide* will indicate the main papers of the essay type which may be found in popular magazines and which are serviceable in a course on the history of science. Where complete files of the older technical journals are available, they will naturally be put to almost constant use, although in one institution now offering such a course it is declared that there are "none used." In another, the instructor in the history of chemistry refers his pupils to "the best known chemical journals, especially for their obituary notices." Undoubtedly still other features of interest may be found.

Where the students are sufficiently advanced and equipped to handle foreign languages, their investigations are greatly facilitated, for aside from possibly a single periodical in English dealing exclusively with the history of science, there are several of this type in Europe.

One question that arises quite naturally in the projection of a course on the history of science, is whether it shall be of the "cul-

tural" type and perhaps open to the majority of students, or of the sort suitable only for those who have already begun specialization. These are, of course, quite different propositions, but the consensus of opinion is that the latter type—where the student has at least had a fair introduction to the subject—is the one capable of the greatest good. In one instance, a historical study of chemistry and zoology is regarded as a "general cultural course offered to all students who have the scientific background which would enable them to carry the work intelligently." Another institution opens its course on the history of chemistry to all students, "but prerequisites are insisted upon." Some schools simply require that applicants shall have had one full year in the science. Others allow any students within the institution to attempt the work if they wish to, but insist that it be taken by all who are majoring in the department. A geology instructor says that "good training in geology is prerequisite to history of geology"—a requirement which is not very definite. Though one teacher—a chemist—considers his history a purely cultural course, he admits only those who have had some work in organic chemistry in addition to the general courses. Another instructor has a different vision. He hopes that the course which is now open only to students working in his department, will ultimately become a cultural one and open to everyone. At one college giving a history course it is claimed that "the lecturer has maintained a certain standard by assuring himself that each student has taken courses in the biological as well as the physical sciences." The department of chemistry in one of the western universities is in a position to offer a strong course on the history of science from the fact that it admits to this class only "graduate and upper class students in chemistry with extensive prerequisites, including French, German, advanced mathematics, and physics—general courses."

These brief references show that in many institutions it is now possible for those stu-

dents who are specializing to obtain courses on the history of their subject.

PUBLICATIONS BY PRESENT TEACHERS OF THE HISTORY OF SCIENCE

The administrators to whom the present inquiry was directed were asked to supply lists of the papers and books dealing in any way with the history of science and written by members of their instructional staffs. The results obtained are probably in no way a fair indication of what has been accomplished, for aside from the few well-known books already referred to, apparently only a little has been done, even including thesis work, popular biographical sketches, bibliographies, and unpublished papers which have been read before local or possibly state scientific societies.

CONCLUSION

It has been a pleasure to read the comments and suggestions of those who have so generously assisted in the present inquiry. Many of these ideas have been embodied in earlier parts of this paper. By far the majority of the letters received are strongly in favor of pushing the history of science to the position of a regular feature of the curriculum. In some schools the faculty is too small to add any subject whatever to the course of study. In such institutions, it is not unusual that the mathematics professor would be glad to offer a course on the history of mathematics. A physics teacher "would like to see such a course in physics offered, but lack of time makes it impossible at present." In spite of the historical material which every science lecturer now and then introduces into his courses, one of them writes: "most of our students know very little about the history of science. Much more attention should be given to this subject." A professor of chemistry thinks "it very advisable to give a short history of the development of chemistry. Will do it when it can be squeezed in." This indicates the general difficulty.

A college dean, as if sensible of inexcusable negligence, hastens to remark:

We realize the value of this subject as an integral part of a progressive curriculum and we shall in due time organize such a course.

Similar expressions are too numerous to quote here.

A need for such a course is arising.

Of great importance!

I am glad to see interest in this important subject is developing widely.

There is without doubt a place for such courses. . . . I should like to see here and elsewhere a "general cultural" course in these subjects offered. This would be of vast interest to B.A. students who would not be attracted by the more thoroughly scientific courses. (The word "scientific" is probably used here to mean "technical.")

The president of a certain engineering school would not favor any deviation from a rigorous technical presentation of the subject, for he believes "that all subjects are cultural if properly taught and so placed before the students." An eminent chemist has the satisfaction of feeling that his history lectures are "proving helpful to prospective chemistry teachers."

A physics instructor in a prominent university writes:

The history of science, either in its general aspect or in specific fields, is an interesting and valuable part of science training, but it is extremely important that the presentation of such work be such as will arouse interest and give the perspective that will enable the student of science to better understand the order in which facts and theories have developed. Such an understanding of the past will help the student in getting a clear idea of exactly where the boundary line between experimental fact and theory lies. I feel that this vitalizing purpose is essential to the success of such work.

A number of administrators have written that the matter of establishing one or more courses in the history of science is already under discussion. Where the idea is new, a few have questioned the possibility or appropriateness of such a course, but the wide success elsewhere serves amply to answer such objections. For example, a leading university president has expressed some of the

difficulties of the situation with remarkable comprehensiveness, and were it not for this fact that very successful arrangements have been developed on a number of lines throughout the country, his statement of the problem would be quite discouraging. It is, however, worthy of attention.

Two distinct types of courses are possible, and appeal to two distinct groups of students: (1) General courses requiring but a moderate amount of technical knowledge on the part of either instructor or students. (2) More specialized courses given by experts in single branches of science for students who are somewhat acquainted with the science in question. No combination of the two types seems to me possible. Even if a sufficiently polymathic instructor could be found, no group of unspecialized students could follow him, and no group even of specialized students outside their own specialties.

A joint course by the representatives of the several different sciences could, of course, be organized, but could not go far without getting away from the class.

The problem is a hard one.

And yet, like other hard problems, it is meeting with partial solution in many quarters.

In this investigation the data obtained can not be thrown into the form of definite numerical values, for several quite evident reasons. The questionnaire method of gaining information has its own natural weaknesses. All who answer are more or less prejudiced. Some may show an interest that is by no means real, or they may give the answer that they believe will sound best as coming from their institution. Furthermore, no weight has been assigned to the courses considered in terms of the number of semester-hours covered. The size of an institution is not taken into account, nor the number of instructors and students in the science departments. Sometimes deans or presidents have answered questions in a general way that could be handled better by the men in science, and one science instructor has usually replied for all of the science departments. Hence, the replies have not always been as representative as could be desired. Departments given over entirely to experimental

research and instruction naturally have not developed courses from the historical side, although the individual instructors may be quite well versed in the subject. Then again, the answers received indicate that even among these men the distinction between so-called "popular" science and fundamental science is by no means clear.

Lest offence be taken by teachers of political and social history, it should be emphasized that no consideration has been given here to their admirable work in tracing the development of human thought and of their growing appreciation of the influence of scientific progress on all history. Their cooperation is needed at every turn—in developing the special methods of historical research suitable for scientific work—in creating a greater demand for such history, and in producing the literature which may satisfy the new needs.

The various suggestions here made are given for what they are worth. Few points of procedure have been indicated as wholly preferable. They are all the testimony of the men and women whose vision has led them into the struggle to add this true side of history—and of science—to those already in the schools, for it is human history, as well as history of science.

My sincere thanks are extended to all who have submitted their views on any phases of this question. Certain aspects of the investigation will constitute material for reports elsewhere.

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**THE EXPEDITION TO TRINIDAD FOR
THE STUDY OF HOOK-
WORM DISEASE¹**

AN expedition for the study of the life of hookworm eggs and larvæ in the soil was sent out by the department of medical zoology of the School of Hygiene and Public

¹ A full account of the results of the work of this expedition will appear in a series of articles in the *American Journal of Hygiene*.

Health of the Johns Hopkins University to carry on investigations in Trinidad, British West Indies, during the summer of 1921. The expenses of the expedition were paid by the International Health Board of the Rockefeller Foundation. The International Health Board through the Trinidad Ankylostomiasis Commission and the Trinidad government cooperated with work of the expedition. The party from the United States sailed from New York on May 5 and returned on September 17. The expedition was under the direction of Dr. William W. Cort of Johns Hopkins University, and worked in cooperation with Dr. George C. Payne, the director for Trinidad of the International Health Board, who also took an active part in the investigations. The others who took part in the investigations were Dr. James E. Ackert, of the Kansas State Agricultural College, Dr. Florence King Payne, of Trinidad, and Mr. Donald L. Augustine, of Johns Hopkins University. Much of the scientific equipment was shipped from the United States and some was borrowed from the Trinidad Ankylostomiasis Commission. The work was carried out at Princes Town, which is in the south central part of the island, in an area where sugar-cane cultivation predominates. Over seventy per cent. of the people of this region are infested with hookworms. This high incidence of hookworm disease and the close coordination with the control campaign served to suggest problems for work and to give an abundance of material. A private residence was rented for a laboratory and fitted out with the necessary equipment. A large space under this house was utilized for animal pens and laboratory space. The yard surrounding the house was also used in a number of the outdoor experiments.

The investigations of the Trinidad expedition were centered around the study of the phase of the life of the hookworm which is passed outside the human body. An effective attack on the problems of the life of the larvæ in the soil was made possible by the utilization of an apparatus invented by Baermann, which makes it possible to iso-